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U.S. Department
of Transportation

**Federal Aviation
Administration**

Report to Congress

Alternatives Available to Accelerate Commercial Aircraft Fleet Modernization

April 11, 1986

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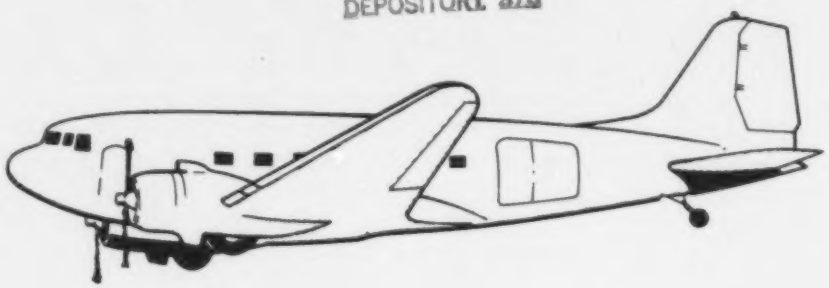

Report of the Federal Aviation Administration to the Senate and House Appropriations Committees Pursuant to House Report 99-256 on the Department of Transportation and Related Agencies Appropriation Bill for FY 1986

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U.S. Department of Transportation
Federal Aviation Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

APR 11 1986

The Honorable William Lehman
Chairman, Subcommittee on Transportation
Committee on Appropriations
House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

This is in response to the requirement in the House Appropriations Committee Report (House Report No. 99-256) on the Fiscal Year 1986 appropriations bill for the Department of Transportation. The enclosed report provides information on various approaches which could be undertaken to accelerate the acquisition of quieter aircraft by operators of the Nation's commercial aircraft fleets. The approaches discussed include both economic incentives and regulatory actions which would encourage or require replacement of noisier Stage 2 aircraft with quieter, more modern Stage 3 airplanes. Actions requiring legislation or rulemaking or both have been considered.

This report was prepared following a public hearing held by the Federal Aviation Administration (FAA) on December 10, 1985. The report takes into account oral and written comments presented at that hearing, as well as written comments which were submitted to the FAA through February 1, 1986.

A copy of this report is also being provided to Chairmen Hatfield and Andrews, Senator Chiles and Representative Coughlin.

I hope this information is helpful.

Sincerely,

Don

Donald D. Engen
Administrator

Enclosure

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Report to Congress:

ALTERNATIVES AVAILABLE TO ACCELERATE COMMERCIAL AIRCRAFT FLEET MODERNIZATION

I. INTRODUCTION

The Federal Aviation Administration (FAA) is pleased to submit this report in response to the request of the Appropriations Committee of the U.S. House of Representatives. In its oversight of the FAA, the Committee included the following statement in House Report 99-256:

> The Committee understands that aircraft noise continues to be a matter of concern for airport neighbors in many major metropolitan areas. It appears to the Committee that a possible long term solution to this problem is the continued replacement of the existing commercial fleet with the next generation of quieter, fuel efficient aircraft.
>
> The Committee is concerned, however, that additional steps could be taken to encourage aircraft fleet modernization. Since it is consistent with federal policy to reduce aircraft noise around the Nation's airports, the Committee directs the FAA, after consultation with interested parties, to report within six months on alternatives available to provide incentives to air carriers to accelerate modernization of the commercial aircraft fleet.

In response to this direction, after publishing a notice in the Federal Register (50 FR 45701, November 1, 1985), the FAA held a public hearing on December 10, 1985, to afford all interested parties an opportunity to present their views. At this hearing 39 speakers provided comments, suggestions, and information on alternatives available to provide incentives to air carriers and other operators to accelerate modernization of the commercial aircraft fleet. A list of the speakers at the hearing and a list of the individuals and organizations that presented papers are contained in Appendix I. The alternatives and approaches supported by speakers and through written statements are identified in Appendices II and III. A number of suggestions were made, orally or in the written comments, that were considered by the FAA but are not specifically addressed in the report. The FAA believes those suggestions have either been included in the discussion of other topics or are more properly addressed in a different context.

Based on information received at the hearing and on the experience and analyses of the FAA, the following report summarizes various approaches to and incentives for fleet modernization, along with the economic and environmental context in which those strategies should be considered. Although a more rigorous analysis of the alternatives was not possible

within the time constraints, the report does describe the advantages and disadvantages of each option. Over the next several months, the FAA will examine the options and determine what action, if any, is appropriate. Although this report contains no recommendations, it discusses certain economic incentives such as investment tax credits and loan guarantees, which are not consistent with the Administration's fiscal policies, as well as some regulatory approaches, such as operational ground and flight restrictions, which would present such serious administrative problems as to raise questions about their viability. Nevertheless, these items have been discussed in the report since they were presented during the public hearing and in written statements by a number of commenters as responsible recommendations that deserve consideration.

The FAA believes the adoption of one or more of the approaches identified in this report should be instituted only as part of a broad program which sets the FAA's environmental goals and objectives concerning aircraft and airport noise for the coming years. In connection with that program, the various options described below would be evaluated for their economic reasonableness and technological feasibility, and would be the subject of a detailed cost/benefit study. Aircraft noise represents a continuing cost to communities and their residents, particularly to such key community services such as hospitals and schools in noise-impacted areas, as well as to airport operators which are the focus of substantial noise litigation. Thus, in examining costs and benefits, community costs in addition to aircraft operator costs must be considered.

The obvious objective of all actions related to the abatement of aircraft noise is to eliminate existing non-compatible land uses and prevent the introduction of any new non-compatible uses. Therefore, a comprehensive national strategy for reaching this objective includes at least the following elements:

(1) improved noise reduction technology for the aircraft;

(2) operational procedures designed for maximum reduction of aircraft noise;

(3) sensible land use planning and control; and

(4) direct actions such as the soundproofing of buildings which must remain in areas of high noise exposure.

As requested by the Congress, this report deals essentially with elements (1) and (2) only, but the FAA recognizes that any comprehensive, national strategy would have to include all the above elements. The FAA estimates that a program with these elements and with the necessary analyses could be completed by early 1987. It would then be appropriate to recommend a specific course of action with respect to particular options.

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II. ECONOMIC AND ENVIRONMENTAL CONTEXT

In this chapter we describe the current environmental and economic background against which the results of any economic incentives or regulatory and legislative approaches to fleet modernization and noise abatement must be viewed.

Using the best available projections for changes in composition of the air carrier fleet over the period through 2005, the characteristics of that fleet have been depicted in Table 1, based on the assumption that no action to expedite fleet modernization would be taken and that acquisition of the quieter, more modern aircraft would be left solely to the market place.

Based on those projections, the environmental effects of no action, compared with the results of the institution of an operating ban on Stage 2 aircraft at various intervals commencing in 1995, are depicted in Figure 3. Assuming that the basic fleet projections are reasonably accurate, the beneficial effect of an operating ban on aircraft noise reduction is significant.

Some idea of the dimensions of the need for a continuing Federal effort to reduce aircraft noise can be gained from the map at page 4 of this report (Figure 1). That map shows the numerous locations within the United States at which airport operators have felt a sufficient need to reduce noise to have taken at least some minor actions to assist that process. While the map does not distinguish between relatively simple actions and those which cause significant changes in the way an airport operates, the sheer number of locations requiring some noise abatement action indicates that aircraft noise continues to be a nationwide problem.

Several additional points should be considered in reviewing this report:

First, although the Congressional directive to examine alternatives for fleet modernization addressed the "commercial" fleet, this report addresses options for both general aviation and the air carrier fleet. It must be recognized that efforts to abate aircraft noise must also involve the fairly substantial fleet of corporate and business aircraft. Unfortunately, it is difficult both to quantify the noise impact from such aircraft on a national basis, and to project changes in the fleets of such aircraft over time.

Second, the FAA did not find it possible to make rational projections of the impact on noise reduction which might accrue from such economic incentives or regulatory approaches as continued investment tax credits or the establishment of preferential ground and flight handling for the quieter aircraft. These techniques, however, are certain to have some positive effect in encouraging the behavior of aircraft operators towards more reliance on the quieter aircraft.

Last, the FAA does not foresee any major technological innovation in the next 20 years which would permit large reductions in aircraft noise. The FAA believes the principal noise reduction over that period will accrue from the acquisition by operators of quieter aircraft built with existing technology and the elimination of the noisier aircraft, rather than from any major breakthrough in noise reduction technology.

EXTENT OF LOCAL ACTIONS TO CONTROL AIRPORT NOISE

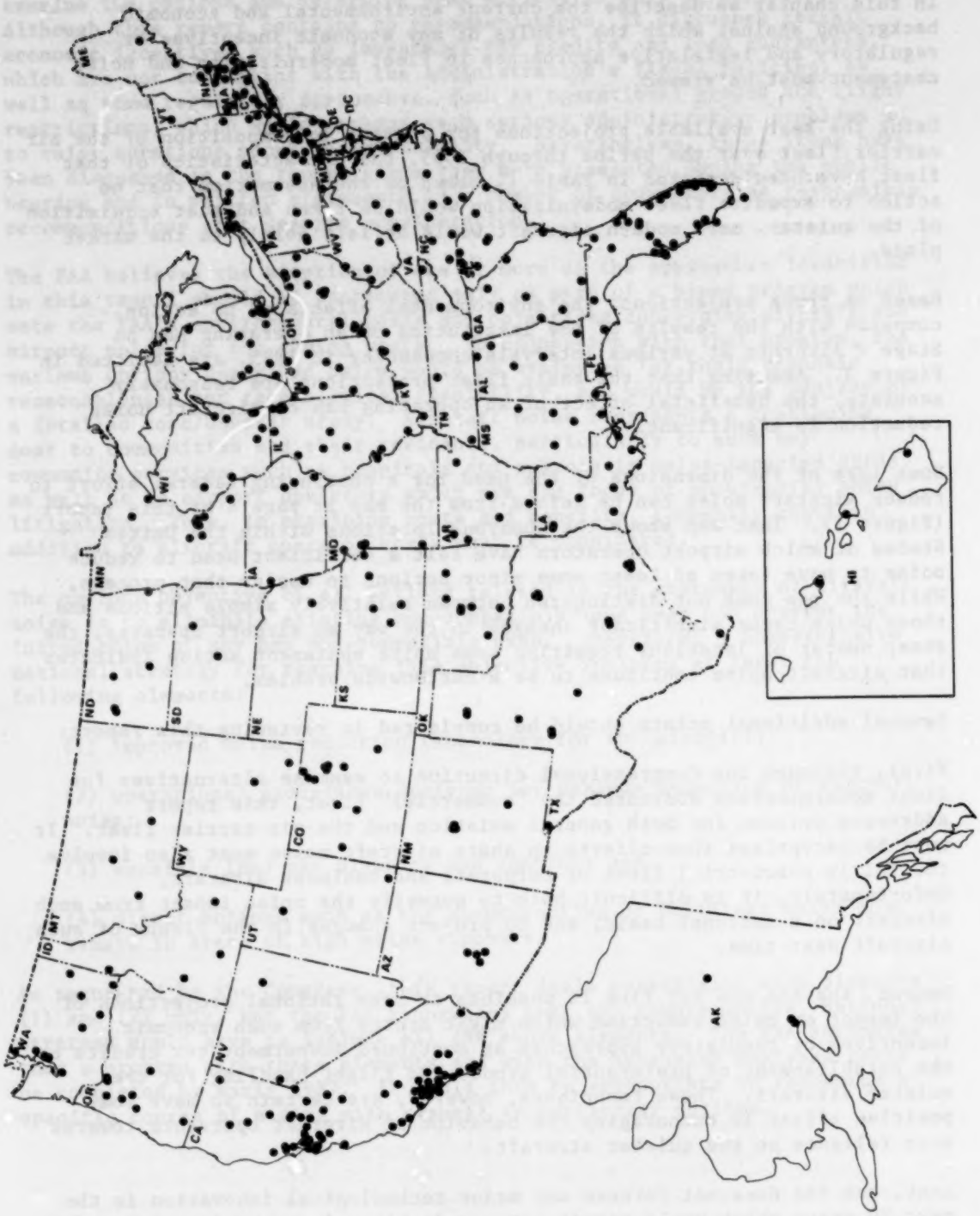


FIGURE 1

A. Current and Projected Airline Fleets.

Domestic air carrier revenue passenger miles are forecast to increase at an average annual growth rate of 4.2 percent during the 1985-2005 time period. Domestic enplanements are forecast to increase by 4.4 percent annually during the same period. Air carrier aircraft operations are forecast to increase at an annual rate of 2.1 percent over the forecast period. The high growth in revenue passenger miles and enplanements relative to operations reflects the baseline air carrier assumptions of higher load factors, larger seating capacity for air carrier aircraft, and longer passenger trip lengths. Jet fuel prices are assumed to decrease over the next three years settling at an average price of $0.733 per gallon before resuming an upward trend in 1989.

Based on the above assumptions, the U.S. air carrier fleet is forecast to grow at an average annual growth rate of 2.1 percent over the period 1985-2005. Table 1 presents the current fleet composition and the forecast mix over the sample period. Based on 1984 end-of-year historical data, approximately 80 percent of the U.S. air carrier fleet currently consists of Stage 2* or exempted Stage 1 airplanes. Except for a minimal number of B-737-200's and B-747's, all currently manufactured airplanes over 75,000 pounds maximum certificated weight are Stage 3 airplanes. Table 2 shows the average age of the Stage 2 fleet as operated by the major and national air carriers. As a result, current projections indicate that by 2005, Stage 2 airplanes will constitute approximately 11 percent of the U.S. fleet; however, they will probably not be used in the higher frequency airline systems. Of course, major changes in fuel prices could change these projections.

The recent drop in crude oil prices will likely result in lower fuel prices than those used in the forecast. Lower fuel costs may make operation of Stage 2 aircraft more attractive to certain regional and cargo carriers, possibly prolonging their use. However, recent mergers among various airlines may lead to fleet rationalization with the emergant larger airline consolidating its fleet by retiring older, obsolete aircraft. Lower fuel cost also leads to increased operating profits which may help stimulate fleet modernization.

A number of Stage 1 aircraft have been or are now in the process of being retrofitted. Due to the large capital investment for hush kits and compliant engines, a significant portion of these aircraft will continue operations well into the 1990's. Thus, for purposes of this forecast all Stage 1 aircraft currently operating under special exemptions have been grouped into the Stage 2 category.

---

* Stage 1, 2, or 3 refers to noise standards for turbojet and transport category airplanes as defined in Part 36 of the Federal Aviation Regulations (14 CFR Part 36). Stage 1 aircraft are those which do not meet any noise standards. Stage 2 aircraft meet the initial standards first issued in 1969. Stage 3 aircraft meet the more stringent standards issued in 1977 and contain the best noise control technology currently available.

TABLE 1

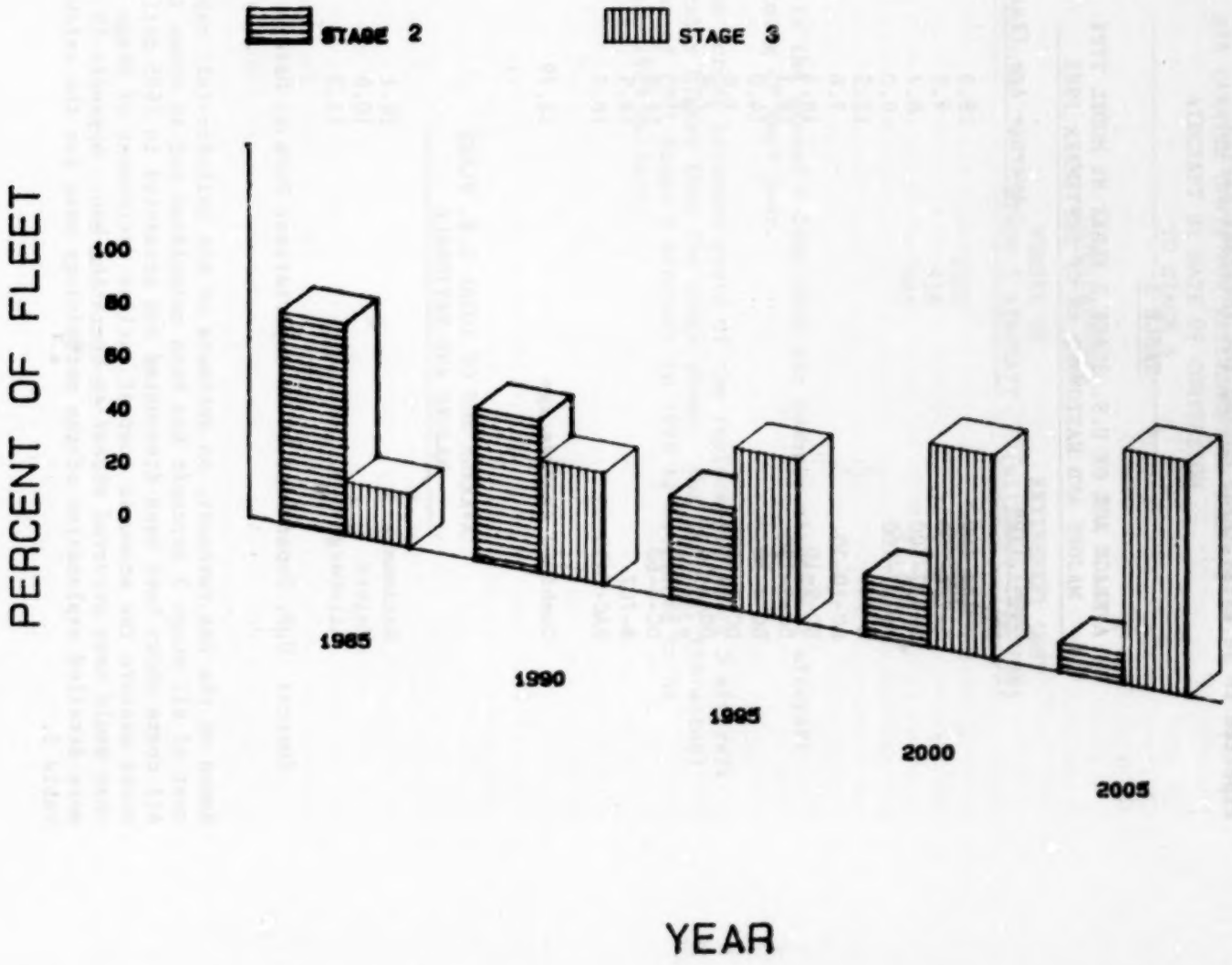
FAA U.S. FLEET FORECAST - 1985-2005

Stage 2	1985(1)	1990(2)	1995(2)	1998(2)	2000(3)	2005
DC-8-50/61	15	0	0	0	0	0
DC-8-62/63 (4)	39	35	31	25	18	0
DC-9	477	410	285	218	139	84
DC-10-30	33	38	38	38	36	25
B-707 (4)	29	29	25	19	14	0
B-727-100	337	125	40	24	16	0
B-727-200	851	792	591	442	381	141
B-737-100/200	392	386	315	262	206	134
B-747 SP	13	13	13	13	12	8
B-747-100	13	13	13	13	12	8
B-747-200	108	108	108	108	100	90
BAC-1-11 (4)	36	25	16	9	3	0
F-28	24	29	26	23	21	15
Subtotals	2367	2003	1501	1194	958	505
Stage 3						
MD-80	128	286	302	302	302	302
MD-8X	0	26	143	182	211	385
DC-8-70	69	77	77	68	68	60
DC-10-10/40	142	142	142	142	142	130
MD-11	0	1	10	13	20	35
L-1011	106	106	106	106	106	106
A300	38	49	52	52	52	52
A310	0	18	20	20	23	32
A320	0	12	58	72	78	105
TA11	0	0	6	15	25	45
TA9	0	0	1	9	17	35
F-100	0	11	28	33	36	36
BAE-146	14	43	43	43	43	43
B-737-300	7	288	406	448	460	460
B-737-400/500	0	20	51	61	67	75
B-747-200 (5)	27	29	29	29	29	29
B-747-300/400	0	28	80	113	124	160
B-757	23	175	372	492	520	679
B-767	54	170	359	485	594	715
B-7J7	0	0	98	218	310	495
Subtotals	608	1481	2383	2903	3227	3979
Totals	2975	3484	3884	4097	4185	4484
Stage 2	79.6%	57.5%	38.6%	29.1%	22.9%	11.3%
Stage 3	20.4%	42.5%	61.4%	70.9%	77.1%	88.7%

(1) Historical data for year-end 1984. (2) Official FAA Forecast.
(3) The years 2000 & 2005 are unofficial estimates based on current trends.
(4) Hushed versions of Stage 1 airplanes.
(5) About 20 percent of U.S. 747-200 fleet meets Stage 3 standards.

FIGURE 2

FAA U.S. FLEET FORECAST
1985 - 2005



The FAA notes that the growth projections given here and in Table 1 do not take into account variations in growth rates at specific airports or in specific regions of the country. Some airports are limited by capacity, environmental and policy constraints and will experience relatively slow growth rates. Others will grow more rapidly due to their locations, sizes, and local economic conditions. Airports recently adopted as hubs are expected to experience relatively faster growth, and some new hubs are expected to be established during the forecast period.

TABLE 2

AVERAGE AGE OF U.S. STAGE 2 FLEET BY MODEL TYPE
MAJORS AND NATIONALS AS OF SEPTEMBER 1985

Model Type	Average Age (Years)
B-727-100	19.9
B-727-200	9.9
B-737-100	8.2
B-737-200	9.0
B-747	12.5
DC-10-30	7.8
DC-9-10	18.3
DC-9-15	18.3
DC-9-30	14.0
DC-9-40	7.0
DC-9-50	7.8
F-28	7.1
DC-8-60	14.8
B-707	18.5
BAC-1-11	18.7
Combined average age	12.79

AVERAGE AGE OF TOTAL U.S. FLEET
MAJORS AND NATIONALS

Nationals	10.1
Majors	10.8
All-Cargo	11.3

Source: U.S. Department of Transportation, Form 41 Data.

Based on the FAA forecast, an estimate of the tail-for-tail replacement cost of all stage 2 aircraft has been calculated and is shown in Table 3. All costs shown have been discounted and presented in 1985 dollars. These costs measure the economic cost of earlier retirement of Stage 2 aircraft than would have occurred absent an operating ban. Appendix IV contains a more detailed explanation of the methodology used for the calculations in Table 3.

TABLE 3

AIR CARRIER COSTS FOR RETIREMENT OF STAGE 2 AIRCRAFT BY DATE OF CONVERSION TO STAGE 3

TAIL-for-TAIL

YEAR OF CONVERSION	NUMBER OF STAGE 2 AIRCRAFT	RETIREMENT COST (millions-1985 $$$)
1995	1501	$9,082
2000	958	$3,822
2005	505	$1,183

* The numbers in the second column show the numbers of Stage 2 aircraft at the beginning of each year.

Note that the actual purchase costs of the replacement Stage 3 aircraft are considerably higher than the costs shown. For example, the actual purchase cost of 1501 Stage 3 aircraft in 1995 is estimated to be 41,914 million 1985 dollars.

B. Noise Impacts of Current and Projected Airline Fleets.

It is currently estimated that approximately 5 million U.S. airport neighbors are affected significantly by airport noise. Approximately that number of airport neighbors reside within areas exposed to an average day-night sound level of 65 decibels (Ldn 65) or greater. The Ldn 65 level of noise has been identified by the FAA as the maximum normally compatible with residential development. Overall airport noise impact has decreased gradually in recent years as the noisiest Stage 1 aircraft have been forced to retire or be modified to meet Stage 2 noise standards, and the quieter, Stage 3 aircraft have come into service. The trend toward decreased airport noise impact will continue as the proportion of Stage 3 aircraft increases in the U.S. and world fleets.

Based on the projected growth and aircraft mix of the U.S. fleet over the next 20 years (Table 1), and the growth in number of aircraft operations at U.S. airports, we project the calculated changes in airport noise impact through the year 2005 (Figure 3). Using 1985 as a base year, the area of land encompassed by Ldn 65 will decrease steadily and will decrease by approximately 32 percent by the year 2000, and by approximately 48 percent by the year 2005. This assumes that no new initiatives are adopted to accelerate the introduction of Stage 3 aircraft and that no significant numbers of used Stage 2 aircraft are imported back into the U.S. By comparison, the upper curve of Figure 3 illustrates that, if the percentage of Stage 3 aircraft in the U.S. fleet remained the same as it was in 1985, and the same forecast growth in operations took place, the impacted land area would increase by approximately 26 percent by the year 2000, and by approximately 32 percent by the year 2005. These increases in noise impact would be due solely to the projected increases in numbers of air carrier operations at U.S. airports. The differences between these increases, due to increased operations, and the projected decreases in noise impact, for the projected higher proportion of Stage 3 aircraft despite the same increases in operations, reflect the dramatic effect of the quieter airplanes.

Figure 3 also indicates the projected advantages of an accelerated changeover to an all-Stage 3 U.S. fleet by the year 1995, 2000, and 2005. If the entire U.S. fleet could be converted to Stage 3 aircraft by 1995, the area of land impacted by noise would be decreased by approximately 69 percent compared to the noise impacts in 1985. A complete changeover by the year 2000 would provide a decrease by approximately 67 percent from the area impacted in 1985. And, in 2005, an approximate decrease of 65 percent would be achieved, again compared to the base year 1985. Of course, the practical benefits for an all-Stage 3 fleet in each of the 3 years shown are the differences between the calculated impacted land areas with an all-Stage 3 fleet and the impacted areas which would be present if no actions are taken to accelerate fleet replacement. Note that the amount of land impacted increases for an all-Stage 3 fleet from 1995 through 2005, again due solely to the projected increase in aircraft operations over that period.

Clearly, the sooner that the entire U.S. fleet could be converted entirely to Stage 3 aircraft, the greater would be the relative improvement in

noise impacts. Of course, at some future date, all of the older, noisier Stage 2 aircraft will have been retired, because of age or economic inefficiency. For example, Figure 3 indicates that, based on the forecasts used here, Stage 2 aircraft will essentially be phased out of the U.S. fleet by approximately the year 2010, and an all-Stage 3 fleet will have been achieved without any incentives. Past experience has shown, however, that older aircraft do not phase out of operation in accordance with forecasting models, and many older aircraft tend to remain in use well beyond their efficient lives. Thus, the relative decreases in noise impacts calculated 20 years or more into the future must be viewed with some caution.

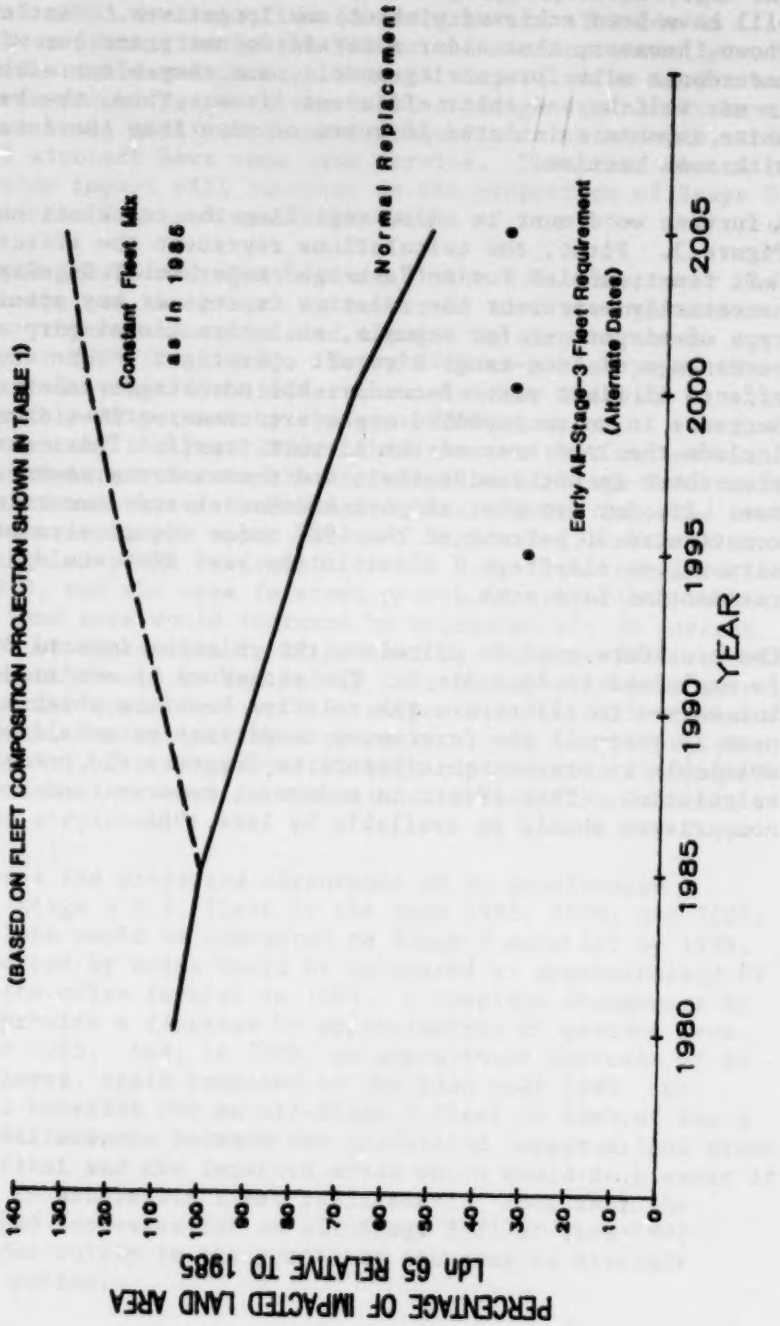
A further word must be added regarding the calculations presented in Figure 3. First, the calculations represent the effects of the national U.S. fleet, scaled for an "average" major hub U.S. airport, and do not necessarily represent the relative impacts at any specific airport. The type of airport -- for example, an international airport with a large percentage of long-range aircraft operations -- can change the relative effects of fleet mix. Secondly, the advantages calculated for relative decrease in noise impacted areas are conservative, inasmuch as the areas include the land area of the airport itself. Thus, some of the impacted area shown is not residential, and does not represent noncompatible land use. If, for example, airport boundaries and commercial/industrial uses constituted 30 percent of the 1985 noise impact area at this "average" airport, an all-Stage 3 fleet in the year 2000 would impact essentially no residential land area.

The procedure used to calculate the relative impacts displayed in Figure 3 is explained in Appendix V. The procedure is admittedly somewhat inexact, but serves to illustrate the relative benefits which are possible over the next 20 years if the forecasted conditions materialize. The time available to present this Report to Congress did not permit a more exact calculation. That effort is underway, however, and more accurate comparisons should be available by late 1986.

FIGURE 3

PROJECTION OF FLEET MIX IN RELATION TO Ldn 65 IMPACT AREA

(BASED ON FLEET COMPOSITION PROJECTION SHOWN IN TABLE 1)



C. New Technology.

The Stage 3 noise standards of Federal Aviation Regulations, Part 36, currently represent the best available state-of-the-art in aircraft noise control which is technologically practicable and economically reasonable. Stage 3 aircraft represent improvements by as much as 25 decibels over first-generation Stage 1 models. Since a reduction of 10 decibels is normally perceived as a reduction of one-half in the loudness of a noise event, a reduction of 25 decibels represents a five-sixths reduction in the loudness of these aircraft. This is a significant improvement.

Nevertheless, Stage 3 aircraft are not silent, although they incorporate all of the available technology. Unless new breakthroughs in noise control technology can be achieved, any small additional improvements will only be obtained through associated losses in aircraft performance and energy efficiency. No new breakthroughs are now foreseen.

Much has been written recently regarding the possibility that new propeller technology for transport category aircraft, with such names as "propfan" or "unducted fan", will improve fuel efficiency. Basically, these concepts utilize a multi-bladed propeller with broad, shaped blades to provide propulsive thrust in lieu of the high-velocity jet exhaust of turbofan engines. In general, these aircraft are being designed to meet Stage 3 noise standards, and, at least at the present time, do not offer any great improvement in individual aircraft noise.

Another limiting factor regarding further noise reductions, at least during approach and landing operations, is the turbulent boundary layer noise created by the aircraft structure itself as it moves through the air. This turbulence is largely created by surface discontinuities on the airframe, including landing gear, landing gear wells, flaps, and other features which disrupt smooth air flow. Consequently, with modern jet aircraft at lower power settings typical of approach maneuvers, this turbulent airframe noise is on the same order of magnitude as the engine noise, and thus presents the noise "floor" below which further improvements are infeasible.

Finally, it must be remembered that aircraft engine and airframe designs are a compromise among a number of efficiency and performance factors. As a result, designs cannot emphasize only noise performance during approach and departure, but must consider also aerodynamic performance and efficiency in climb and cruise. For example, the ability to cruise at higher altitudes than those used at present could aid significantly in increasing the capacity of en route airways. With most of today's modern aircraft operating en route at flight levels between 29,000 and 35,000 feet, airway capacity is becoming constrained. Thus, engine/airframe designers must keep in mind performance factors other than approach and departure noise in providing productive aircraft.

In summary, the newest Stage 3 aircraft represent the best available noise performance for the foreseeable future, consistent with economic reasonableness and technological practicability. As shown in the preceding section, the conversion to an all-Stage-3 fleet in the U.S. can achieve dramatic improvements in airport noise control. But this will not eliminate the airport noise problem. The FAA must continue to emphasize local airport noise compatibility planning to address the residual noise impacts, even when, in the future, the entire fleet consists of Stage 3 airplanes.

III. ECONOMIC INCENTIVES FOR FLEET MODERNIZATION

This chapter contains a brief description and analysis of various economic incentives which might lead operators to modernize their fleets. Any national program for accelerating aircraft fleet modernization could include one or more economic incentives, as well as regulatory approaches. The economic incentives could be structured to encourage the purchase and operation of Stage 3 aircraft, while regulations could be used to provide appropriate disincentives to the further operation of the noisier Stage 2 airplanes and to limit the further introduction into the U.S. of additional Stage 2 aircraft.

The proposals discussed in this part of the report are described as "incentives" because they leave to the operators the choice of whether to take advantage of them. Essentially, the marketplace will determine the extent to which these options, or any one of them, will result in the reduction of aircraft noise. Of course, the purpose of the incentives described here is to alter the nature of the marketplace in ways which will encourage operators to find that it is in their own best economic interest to take steps to acquire the quieter and more efficient Stage 3 airplanes.

The economic incentives described here would apply to the air carriers and other operators of commercial fleets. They would, in every instance, require legislative action to implement. During any consideration of such legislation, it would be necessary to carefully define the scope of the proposed incentive. For instance, which economic incentives, if any, would be available to general aviation and corporate operators? Which would be available to foreign-flag air carriers serving U.S. airports? If none of the incentives would be available to foreign operators, would they also be exempt from the regulatory constraints? Finally, what would be the competitive effects on U.S. air carriers?

The discussion of these incentives, whether they are economic incentives such as those discussed in this chapter or the regulatory and statutory actions discussed in Chapter IV, is based on the present composition of the fleet, as well as the best available forecast of how the fleet is expected to change over time if no rules or incentives are applied, as depicted in Table 1. Because of the uncertainties involved, no attempt has been made here to quantify the impact of any of the rules or incentives on the composition of the fleet in the long term.

The incentives described here are ones for which some precedent exists. They are also ones deemed possible despite the present constraints due to the budget deficit. Other incentives, such as outright grants for the purchase of Stage 3 aircraft, have been omitted as unrealistic. Lastly, one alternative economic incentive is that of funding the development of Stage 3 retrofit technology. Federal funding of this development was recommended by several speakers during the FAA public hearing.

A. Investment Tax Credit (ITC).

An ITC is a tax reduction traditionally used to stimulate business purchases for specific investment purposes. When an ITC is in effect, a firm making a capital investment which meets certain requirements may credit a portion of the investment against the amount owed by the firm in taxes. Under the Economic Recovery Tax Act of 1981, a 10 percent ITC was allowed for major purchases such as aircraft. Clearly, the larger the credit, the greater the incentive to make capital investments.

The effect of the tax credit is to lower the net purchase cost of an airplane to an operator, but only so long as a tax liability is currently present or is present in a future year to which the credit may be carried forward. For qualified property, the tax credit may amount to $25,000 of tax liability plus 85 percent of the tax liability exceeding $25,000. For used property, the investment credit can be applied, at most, to property with a value of $125,000 ($150,000, as of 1987). Even if the full credit amount cannot be used in the year of purchase, carry-over provisions are allocated to following years. For purposes of tax depreciation, the depreciable basis of the asset must be reduced by 50 percent of the investment tax credit taken. The tax reform legislation passed by the House in late 1985 would abolish the ITC commencing in 1986. Therefore, legislative action would be needed to retain the ITC for use solely for Stage 3 aircraft.

The availability of the ITC and accelerated depreciation (see page 16, below) has spawned a large market for leased aircraft. Airlines unable to take advantage of tax deductions have turned to leasing aircraft from banks and other syndicates which are better able to take advantage of the ITC. The net result has been an increase in the number of aircraft available. It is estimated that approximately one-third of the world's fleet is leased.

Various alternatives which make use of the ITC as an incentive to aircraft fleet modernization include:

- Full retention of the ITC, as it is currently available, for all Stage 3 aircraft purchases.

- Full use of the ITC only when substituting one Stage 3 aircraft for each Stage 2 aircraft removed from the U.S. registry.

- If budget concerns dictate the abolishment of the ITC, an incremental 2 percent per year reduction of the current 10 percent ITC could be implemented over the next 5 years. The net effect would be to stimulate Stage 3 aircraft purchases in the near term.

Advantages

- Significantly reduces the net purchase cost to an operator.

- Requires no direct government outlay.

- Would encourage leasing companies to acquire Stage 3 aircraft thereby increasing the number of such aircraft available to operators which cannot afford to purchase them.

Disadvantages

- Is not consistent with Administration policy.
- Reduces tax revenues to the U.S.
- Is available only to those operators with a tax liability.
- Would require legislation if the pending tax bill eliminates the ITC.

B. Accelerated Depreciation.

Depreciation is the reduction in value of an asset as a result of wear and tear. Since the consumption of capital assets is a cost of earning revenues, it is recognized in current tax law as a deductible business expense. An allowance for depreciation of a company's assets is always made before the calculation of profit, thus reducing the taxable income to the owner of the asset.

Accelerated depreciation allows an asset to be depreciated over a life shorter than its real economic life. In the case of an aircraft, this permits a larger percentage of the cost of its value as an asset to be written off in the early years of its life and a correspondingly smaller percentage in later years. The accelerated depreciation allowance helps reduce the net cost of purchase of new, quieter aircraft. Because of the time value of money, the deferral of taxes has a real economic value to the operator, often increasing the internal rate of return on the newer aircraft.

Currently, businesses purchasing aircraft are entitled to an accelerated depreciation schedule for any aircraft purchased. To encourage modernization of the U.S. fleet, adjustments to the depreciation schedule could act as an incentive if the accelerated depreciation schedule were amended to allow accelerated depreciation only for new or used Stage 3 aircraft. Alternatively, a further incentive would be to require all other aircraft to use a straightline method of depreciation. Since depreciation allowances are a form of government subsidy, continuing to permit any depreciation allowance for Stage 2 aircraft would, in effect, provide a continuing subsidy for the purchase and operation of those aircraft, while an accelerated depreciation allowance for Stage 3 aircraft only would provide a greater incentive for acquisition of such aircraft.

Advantages

- No direct government outlay is required.
- Could stimulate new investment in Stage 3 aircraft.
- Would encourage leasing companies to buy Stage 3 aircraft making more such aircraft available to operators that cannot afford to buy them.

Disadvantages

- Is not consistent with Administration policy.
- Would reduce tax revenues to the U.S.
- Is only available to those firms which pay taxes, and many of the operators in most need of more modern aircraft are not profitable.
- Would require legislation.

C. Loan Guarantees.

Broadly defined, a guaranteed loan is a debt obligation for which an agency of the Federal Government pledges to pay part or all of the amount due to a lender or loan holder in the event of default by the borrower. A loan guaranteed by an agency of the Federal Government is a contingent liability to that agency. Loan guarantees, when provided by the Federal Government, make credit available to prospective borrowers when private financial sources would not do so otherwise. Even when alternative private sources are available to provide funds, loan guarantees make that credit available at more favorable terms to the borrower by placing the risk of loss upon the governing agency.

As discussed elsewhere, Federal incentive programs are established to accomplish diverse objectives. Previously, loan guarantees administered by the FAA were used to help finance the fleets of small air carriers which provided small community service. In order to provide an incentive to fleet modernization, loan guarantees should only be considered for airlines seeking to purchase Stage 3 aircraft. Determining eligibility for this type of program may be difficult. Questions need to be addressed concerning airline size; whether freight carriers and leasing corporations should be included; and whether a secondary market should be established. Though this report makes no recommendation, several proposals are offered for discussion.

Since a major portion of older Stage 2 aircraft are purchased by new, small airlines established as a result of deregulation, loan guarantees might be restricted to small entities, such as airlines operating nine or fewer aircraft or made available only for purchase of hush kits and new, compliant engines if such engines become available.

In light of the present budget difficulties, funding for such a program could be obtained from several sources: revenues from the Airport and Airway Trust Fund could be used to support this program; increased ticket taxes to supplement the existing Trust Fund or to create a new noise Trust Fund could be imposed to fund a loan guarantee program.

Advantages

- Helps needy operators obtain loans which the private market may not provide.
- Redirects allocation of resources towards quieter aircraft.
- The FAA is familiar with administration of a loan guarantee program.

Disadvantages

- Is not consistent with Administration policy.
- Would reduce tax revenue to the U.S. or require tax increase.

- Difficult to establish eligibility requirements.
- Requires legislative action.
- Could encourage over-investment by marginal operators.
- Would require substantial FAA resources to administer.

E. Federal Funding of Stage 2 Retrofit Development.

As part of its justification for the regulatory phase-out of Stage 1 aircraft by 1985, the FAA demonstrated the technology to modify Stage 1 aircraft in order to bring them into compliance with Stage 2 noise standards. For about 91 percent of the current Stage 2 U.S. fleet (2160 out of 2367 aircraft in 1985, from Table 1), no "retrofit" is available to bring these airplanes into compliance with Stage 3 noise standards. All of these aircraft would have to be replaced, with the costs indicated in Table 3, to reach an all-Stage 3 fleet unless "retrofit" technology were developed.

The "quiet nacelle" or "hush kit" technology applied to Stage 1 aircraft to permit them to meet Stage 2 standards is insufficient to achieve Stage 3 compliance. In effect, the older Stage 2 aircraft would have to be re-engined to achieve improved noise performance, using high-bypass turbofan engines. One example of this re-engining is the conversion of DC-8-61/62/63 aircraft to DC-8-71/72/73 versions, by replacing the older JT3D engines with newer CFM-56 engines at a cost of about $18 million per airplane. As a result, these re-engined airplanes comply with the Stage 3 noise standards by a comfortable margin, while at the same time providing substantial improvements in productivity and fuel efficiency. Such modifications have not been developed for other Stage 2 aircraft, however, especially the majority which are powered by JT8D and Spey engines. A development program for converting the BAC-1-11, 400 series, using new TAY engines, has just been announced, with a projected cost of $6.5 million per airplane.

Federal subsidy or full support of re-engining development programs for the older Stage 2 aircraft could provide an incentive for future conversions of these aircraft to meet Stage 3 standards by assuring the availability of these conversions and defraying the developmental costs. Such conversions provide the added incentives of greater productivity and fuel economy to operators of these aircraft, especially in the event of new crude oil supply shortages and consequent higher fuel costs.

Advantages

- Helps assure the commercial availability of conversion programs.
- Substantially reduces the net conversion cost to operators, compared to replacement.
- Provides improved efficiency of national fuel usage.

Disadvantages

- Involves Federal participation in commercial developments.
- Requires substantial commitment of Federal funds.
- The Administration has moved away from subsidies in most areas, including transportation.

IV. REGULATORY APPROACHES TO FLEET MODERNIZATION

This section presents a brief summary and analysis of each regulatory approach that might contribute to the acceleration of fleet modernization. In general, such actions fall into two broad categories: those that can be put into place by FAA regulation under existing statutory authority and those that would require additional Congressional action.

Each summary sheet includes a brief description of the alternative action, the advantages and disadvantages of its adoption, an analysis of its expected impacts, and whether it is dependent upon any other alternative(s).

While this section presents several alternatives, additional choices could be "built" from them by assembling packages of alternatives or parts thereof. For example, both operational flight and operational ground procedures could be put into effect at a particular location, or an operating ban and the modification of present noise standards could be introduced simultaneously. As noted above, any of these approaches can also be coupled with one or more of the economic incentives described in Chapter III to produce a broader, more comprehensive approach to fleet modernization.

A. Stage 2 Non-Addition Rule.

Nearly all aircraft currently in production in the United States and worldwide are certificated to the Stage 3 noise standards established by Part 36 of the Federal Aviation Regulations. Manufacturers have only a very few unfilled orders remaining for the older, noisier, less fuel-efficient Stage 2 airplanes. These orders should all be filled by the end of 1987.

The demand for aircraft of all types is expected to be strong through the end of this century (see Table 1, p. 6). Part of this demand by smaller and new entrant operators will be filled by used aircraft, the majority of which will be Stage 2 models, sold by the larger carriers as they modernize their fleets with new Stage 3 aircraft. Some of these used airplanes will be imported from overseas as larger foreign carriers convert their fleets to Stage 3 models and put their older aircraft on the world market. The flow of used aircraft into U.S. fleets could also be increased as other governments or regions of the world enact rules limiting the use of Stage 2 aircraft there. An example of this is the proposed 1996 limit for operating Stage 2 aircraft into and within the European Community. As that date approaches, European operators will be looking for places to dump their Stage 2 fleets. Without a regulation to prevent these imports, the U.S. Stage 2 fleet can be expected to grow in future years, rather than shrink.

To address these problems, FAA could promulgate a new regulation which would prohibit the addition of any Stage 2 aircraft into the U.S. fleet on or after a specific date, such as January 1, 1988. This regulation would not prohibit U.S. manufacturers from producing new Stage 2 aircraft solely for export, as a complete production ban would. Nor would it prohibit sales or transfers of currently registered Stage 2 aircraft among U.S. operators.

Advantages

- Would "cap" the total number of Stage 2 airplanes registered in the U.S.; growth would come with Stage 3 aircraft.
- Would prohibit dumping used Stage 2 airplanes in the U.S.
- Would not limit free-market transfers of Stage 2 aircraft within the U.S. fleets.
- Would not prevent U.S. manufacturers from producing new Stage 2 aircraft for export to foreign markets where noise rules do not prevent their use.

Disadvantages

- By itself, would provide limited incentives for accelerated fleet conversion.
- Would not affect foreign-registered aircraft operating in the U.S.

B. Stage 2 Operating Ban at Critical Airports (Local Option).

Currently, one of the most effective incentives for air carriers and other operators of large turbojet airplanes to modernize their fleets is provided by certain local airports -- not the Federal Government. This incentive is the proliferation of local limitations on noisy aircraft, particularly during the nighttime hours. Such limitations are often expressed as the maximum allowable noise on takeoff or approach and are compared for each airplane type to FAA published numbers or to locally measured averages.

The courts have held that local airport proprietors may set limits on noise-producing events either by completely banning the noisiest aircraft types or by limiting the total number of operations of those types as a means of achieving reasonable prescribed cumulative noise level goals or of ensuring that such levels are not exceeded, so long as these limits do not impose an undue burden on interstate or foreign commerce and are not unjustly discriminatory or unreasonable. Further constraints on setting local limits may stem from contractual obligations with aircraft operators or with the FAA as a result of the receipt of Federal funds in the past.

Airlines complain that the nearly random nature of the imposition of local regulations makes flight scheduling extremely difficult. As a result, the FAA has monitored this activity carefully to ensure that limitations are reasonable and nondiscriminatory and that they impose no undue burden on interstate or foreign commerce. Monitoring and review are made more difficult by the tendency of some communities to revise their restrictions several times a year.

Advantages

- Ongoing, involves little or no Federal action.
- Allows local airport choices to be made on noise levels vs. air service levels without national regulation.

Disadvantages

- Differing local noise level vs. service level choices make airline scheduling difficult, possibly expensive.
- No requirement exists for the FAA to be notified about pending actions by airport proprietors.
- Once notified (often by local aircraft operators), FAA reviews are often difficult and time-consuming, response options are limited.
- No requirement exists that airport proprietors review alternative noise abatement actions to assure adoption of those which least restrict air commerce.
- Airport proprietors are not required to consider impact of noise restrictions on national air transportation system and many do not have information needed to do so.
- Individual restrictions may not unduly burden interstate commerce, but in the aggregate they may be such a burden.

C. Nationwide Stage 2 Operating Ban (Fixed Date).

In 1976, the FAA adopted a rule prohibiting certain domestic Stage 1 (non-noise-certificated) airplanes from operating in the United States on or after January 1, 1985. As directed by Public Law 96-193, the FAA in 1980 extended this rule to apply also to U.S. international and foreign aircraft operated to the U.S. One alternative that has been proposed is for the FAA to similarly ban Stage 2 aircraft operations after a future date, such as January 1, 1995.

Many western countries are considering such a rule at this time, but none has yet actually adopted it. From experience gained with the earlier Stage 1 operating ban, it can be concluded that some third world countries, particularly smaller Latin American and Caribbean countries, would suffer economically if a single cutoff date were imposed. The impact on those countries would arise from their need to completely change the composition of their passenger and air cargo fleets over a relatively brief period. Even though nations and airlines affected are notified months or years in advance of an operating cut-off date, they may yet find it difficult to obtain financing for replacement aircraft. The problem is intensified if only a few used complying aircraft are on the market.

One version of this alternative which might relieve (although not completely dispel) these impacts would be to phase out the older airplanes over several years. The Stage 1 operating ban that applied to U.S. domestic operators contained such a requirement, while the foreign operator rule did not. Thus, many of the more severe effects of the rule fell on international operators.

A phased conversion might be based on fixed percentage goals being met each year or two. This is the system that the FAA used for its Stage 1 domestic rule.

Advantages

- Would be uniformly applied to all operators of affected aircraft.
- Federal action could inhibit proliferation of differing local rules and thereby ease the economic impact of such rules.
- Could be timed and phased to provide both aircraft operators and local communities specific planning information.
- Would not require further legislative authority.

Disadvantages

- Would decrease the retail market value of Stage 2 aircraft.
- The effective date for such a rule might be limited by the production capacity for Stage 3 aircraft.
- Would affect carriers differently depending on their fleet composition, and may have competitive repercussions.

D. Nationwide Stage 2 Operating Ban (By Age of Airplane).

The preceding alternative is based on setting one or more fixed dates by which some percentage of the affected aircraft must be brought into compliance with Stage 3 standards, exported, or taken out of service. One variation under consideration in western Europe is to guarantee each airplane a minimum service life (possibly 15 or 20 years) before it must be phased out of service. This approach would equitably provide for a reasonable and predictable return on investment while spreading out the required acquisition of complying aircraft.

Phasing out the older aircraft by this method would largely eliminate problems with the production rate of Stage 3 airplanes, since requirements would be known years in advance and large numbers of new airplanes would not be required on any arbitrary date. Similarly, it would simplify planning by aircraft operators for the purchase and financing of replacement aircraft. However, it would be more difficult for airports and surrounding communities to forecast the noise impact for any given date.

Advantages

- Would apply uniformly to all operators of affected aircraft.
- Federal action could inhibit proliferation of differing local standards and thereby ease the economic impacts.
- Could be timed and phased to provide both aircraft operators and local communities specific planning information.
- Would allow uniform period for return on investment before aircraft would have to be modified or removed from service.
- Would not require further legislative authority.

Disadvantages

- Would provide noise relief to nearly all airports, whether or not they are considered to be noise impacted.
- Date of applicability might be limited by production capacity for Stage 3 aircraft.
- Implementation could present serious administrative difficulties.
- Would affect carriers differently depending on their fleet composition, and may have competitive repercussions.

E. National Stage 2 Operating Ban (Limited Federal Preemption).

A safe and efficient system of air transportation is essential to the health and vitality of our Nation. However, some airport segments of that system are actually shrinking due to capacity constraints caused by local airport proprietor-imposed use restrictions, many of which result from reaction to aircraft noise.

Stage 3 noise certification represents the best available state-of-the-art in aircraft noise control which is technologically practicable and economically reasonable. An all-Stage 3 fleet operating without restriction at U.S. airports represents the best current way to meet the national need for a safe and efficient air transportation system.

Past judicial decisions and legislation have made airport proprietors financially liable for the adverse environmental consequences of operations at their airports. Proprietors' concerns with liability often conflict with their efforts to participate fully in an efficient national air transportation system.

One feasible program to protect the national interest and to achieve a balance between local and national responsibilities (and liabilities) could include the following elements:

1. Federal preemption of use restrictions at U.S. airports for Stage 3 aircraft;

2. Federal financial liability for noise damages created at U.S. airports by an all-Stage 3 fleet operating without restrictions;

3. Local proprietor liability for local noise impacts beyond those which would be created by an all-Stage 3 fleet; and

4. Continuing to permit local airport proprietors to impose restrictions on Stage 1 and Stage 2 aircraft, provided such restrictions are not unjustly discriminatory, unreasonable, or unduly burdensome on interstate or foreign commerce.

Advantages

- Would more equitably preserve the Federal interest in a safe and efficient air transportation system without total preemption of local authority and initiative.

- Would leave the burden of motivating operators to modernize their fleets in part on airports having demonstrable noise impacts, but relieve airports of liability for noise damages from Stage 3 aircraft.

Disadvantages

- Would require legislative authority.

- Might create immediate demand for more Stage 3 aircraft than are currently available.

- Might depress the market value of Stage 2 aircraft.

- Could create federal liability for some noise damages.

F. Nationwide Stage 2 Operating Ban (Full Federal Preemption).

The preceding three alternatives are based on the establishment of a fixed date (or dates) by which Stage 2 aircraft may no longer operate into U.S. airports. Such a ban would assure airport neighbors that the benefits of an all-Stage-3 fleet would be achieved by a date certain, and that partial benefits will be gained earlier as the Stage 2 aircraft are phased out of service in anticipation of that deadline. Implicit in the establishment of a fixed phase-out date is a finding by FAA that such date is the earliest which is economically reasonable and technologically practicable in accordance with the provisions of section 611 of the Federal Aviation Act of 1958, as amended.

A fixed phase-out date for Stage 2 aircraft could be combined with Federal preemption of the right of local airport proprietors to restrict the operation of Stage 2 aircraft at their airports prior to the FAA deadline. In effect, FAA would thereby assure aircraft operators of the full use of their Stage 2 aircraft until the Federal deadline.

Advantages

- Would provide a compromise for aircraft operators in return for the accelerated phase-out of their Stage 2 aircraft, by assuring them of a reasonable useful life for those aircraft in the U.S.

- Would prevent a "patchwork quilt" of differing local noise restrictions on Stage 2 aircraft at airports across the U.S.

- Would assure complete phase-out of Stage 2 aircraft by a clearly established date.

Disadvantages

- Federal preemption of the right of local airports to ban Stage 2 aircraft prior to a specific date could shift liability for noise damages caused by Stage 2 aircraft to the Federal Government. FAA believes local airports would continue to be liable for noise damages caused by other aircraft.

- Would create confrontations with airports which have already implemented local restrictions on Stage 2 aircraft.

- May require new legislation in view of the emphasis on maintaining the present balance between Fedeal and airport proprietors' rights contained in such current statutes as the Quiet Communities Act. See, for example, section 105(b)(1) of the Federal Aviation Act of 1958.

G. Operational Flight Procedures.

During the public hearing held by the FAA, several speakers identified possible benefits that might accrue if Stage 3 aircraft were given preferential treatment in the use of operational procedures in terminal areas and en route. For example, the most direct routes between cities could be assigned to Stage 3 aircraft, while Stage 2 airplanes would be given less direct routings, if alternate routings were necessary due to airway congestion. Another proposal was to exempt Stage 3 aircraft from local noise abatement procedures. Both proposals were designed to lessen operating costs for Stage 3 operators and provide increased incentives for early conversion of the fleet.

The first of these plans envisions direct "highways in the sky" that would provide lower costs to both Stage 3 aircraft operators and travellers. Stage 2 airplanes would be assigned to the air traffic equivalent of "side roads." The second proposal follows the same principle, but would provide relief from local noise abatement routings, thrust cutbacks, use of preferential runways, and other procedures all aircraft must currently follow. Although the latter proposal could increase in-service noise levels for Stage 3 aircraft, it would tend to encourage the replacement of Stage 2 fleets and lead to reduced noise over the long term.

Advantages

- Would provide tangible economic incentives to aircraft operators to modernize their fleets.

- Would not require additional legislation.

Disadvantages

- Would add considerable additional workload and pose difficult handling problems for air traffic controllers to provide separate routings for different aircraft by Stages.

- Could lower the capacity of both airports and the national air transportation system as a whole.

- Could raise legal issues concerning preferential treatment by the FAA.

H. Operational Ground Procedures.

Since aircraft operational delays on the ground, as well as in the air, readily translate into economic penalties for both airlines and passengers, it was suggested that local airport proprietors and the FAA provide preferential ground handling treatment for operators of Stage 3 aircraft. Such treatment might include preferential gate assignments and preferential slotting for Stage 3 takeoffs and landings. The latter could be implemented (at least in part) by allowing Stage 3 aircraft to go to the front of the takeoff queue ahead of all Stage 2 airplanes. At the busiest airports, separate Stage 2 and Stage 3 queues could be established, with no Stage 2 aircraft movements until all Stage 3 airplanes had departed. This proposal might not have much discernible effect in the short term while less than one quarter of the fleet is Stage 3, but as that percentage increases, the noise benefits to communities would also increase.

In view of FAA's role in providing departure clearances and in handling aircraft movements on the ground when they involve landings or departures, Federal action would be required to put this alternative into effect at any particular airport. However, such action would be consistent with the FAA's responsibility for the efficient use of the airspace and for ensuring that no undue burden is placed on interstate or foreign commerce.

Advantages

- Would provide immediate economic incentives for operators of Stage 2 aircraft to increase Stage 3 service at airports where such rules were in place.
- Would provide tangible evidence to those serving the airport of the importance of early fleet modernization.
- Could possibly be implemented without Federal legislation.

Disadvantages

- Would cause schedule delays for carriers with a high percentage of Stage 2 airplanes and for their customers.
- Could cause greater congestion and loss of capacity at the busiest airports.
- Could raise legal issues concerning preferential treatment.
- Would pose difficult handling problems for air traffic control.

I. Noise Budgets.

One of the more far-reaching noise control strategies that has been implemented on the local level has been for the airport proprietor to set up a process by which "noise budgets" are assigned to each carrier using that airport. Usually, this begins with the establishment of a noise goal for the airport as a whole, such as prohibiting any increase in or reducing the size of a given noise contour area, for example, the 65 Ldn contour within which aircraft noise can be expected to lead to complaints and possible group action. The noise from each current carrier is then computed, amounts set aside for new entrants and general aviation, and the remainder divided proportionally by some agreed formula. Some have suggested that this process be standardized through regulatory action by the FAA.

Were the proposal that the FAA standardize this process nationally by regulation adopted, it would be necessary, first, for the FAA to define the "noise impacted airports" to which the rule would apply. Definition could be accomplished either by setting a uniform national standard or by developing a process somewhat similar to FAR Part 150 whereby local airports could voluntarily come under the regulation. Next, the process for applying the noise budget at specific airports, including the formula for apportionment among operators, would have to be developed. To increase the incentive to bring a greater percentage of the fleet into compliance with Stage 3, the total noise budget for each airport in the program could be reduced over time.

Advantages

- Would be the most direct means of limiting the noise impacts around participating airports.
- Would provide incentives to aircraft operators, but would leave choice of methods to comply up to them.
- Might not require additional legislation.

Disadvantages

- Would be difficult to set a national standard that would both work on the local level and provide sufficient relief to individual airports.
- Might constitute Federal preemption of local responsibility for local noise problems with concomitant Federal liability for noise damages.

J. Modify Current Noise Standards.

Several options are available to the FAA to encourage the more rapid turnover of the air carrier and commercial fleets that would entail modification of the current FAR Part 36 noise standards. In most cases, these modifications would be issued as a part of a larger package of actions, which when taken together could reasonably be expected to accelerate fleet turnover. Depending upon the specific provisions of the package, Part 36 might be modified to add one or more additional Stages to the two stages for which standards are currently contained in Part 36.

One alternative addressed in connection with the public hearing would add a Stage 2.5 and possibly a Stage 3.5 to allow both the FAA and local airport proprietors more flexibility than the current system provides in regulating aircraft noise through local use restrictions. With an increase in the number of categories of aircraft noise standards, proposed restrictions could be more closely tied to the cost/benefits of the applicable local situation.

Another proposal that might have a similar effect would be to promulgate a Stage 4 standard. Such a rule would have the technological problems discussed earlier in this report. However, it would also have the immediate effect of demonstrating to the airlines that Stage 3 is not an unreasonable requirement and that continuing efforts to reduce aircraft noise must be made. Unfortunately, establishment of a standard that is currently technologically impractical might also unrealistically raise the expectations of airport communities.

A second proposal for modifying FAR Part 36 would lower the Stage 3 takeoff noise level limits for three- and four-engine aircraft only. The current takeoff noise level limits are based on both aircraft weight and number of engines, whereas the approach and sideline limits are based only on weight. As a result, the current rule requires two-engine airplanes to be three to five decibels quieter than three- and four-engine airplanes. While recent advances in technology do not support lowering all three noise level limits, it does appear feasible to lower the takeoff noise levels for three- and four-engine aircraft. If that change were coupled with rules on further production and/or operation, considerably more benefits would accrue from enactment of the package than from any individual piece.

Advantages

- Would provide additional flexibility for crafting local and national noise rules to specific situations with maximized benefit/cost ratios.
- Would increase incentives for further noise abatement research.
- Would not require additional legislation.

Disadvantages

- Would increase the regulatory burden for manufacturers of certain types of aircraft.

K. Noise Fees.

Implementing a user surcharge could be considered for operators which choose to continue to operate their Stage 2 airplanes. The concept of a noise landing fee allows those who cannot afford to replace their aircraft to continue using them as long as the operators are willing to compensate the airport operator, or the public through payments to the Federal Government, for the increased noise. Implementing such a tax system provides a concrete incentive to acquire and use quieter aircraft. The dollar value of the noise landing fee should be set at a level that would not prohibit the continued use of noisier aircraft, but would be high enough to encourage their accelerated replacement.

If a surcharge were adopted, it would become a cost of doing business for airlines or other operators with the cost being passed on to passengers and consumers through higher fares or internalized by the operator through decreased income. A surcharge, for example, would equalize fares among carriers which have made the expenditures necessary to acquire state-of-the-art Stage 3 aircraft and those which continue operation of cheaper, fuel-inefficient Stage 1 and Stage 2 aircraft. Use of a surcharge for noise emissions becomes particularly effective when used as a temporary measure during the interim period before regulatory measures fully effective.

Various methods for establishing noise-based fees include:

- Fees based on certificated Federal Aviation Regulation (FAR) Part 36 noise levels.

- Fees based on specific measured noise levels.

- Various alternatives based on the above with variations based on size of aircraft and number of seats.

The administrative burden would vary depending on the alternative adopted. Landing fees are currently used at virtually all airports around the world. A noise surcharge could simply be added to any existing landing fee and collected through the established system. The more complex a system the more difficult the implementation. If certificated values are not used, monitoring systems may be necessary at the local level resulting in a program overly difficult to enforce.

A noise landing surcharge could be adopted at the Federal level or at local levels where the problem is most acute. Surcharges have been used at various airports in Europe. The most common system involves a monetary value on noise exceeding a specified level. An alternative is an incentive system in which established landing fees are reduced for quieter aircraft.

If the Federal Government were the recipient of revenue from noise-based fees, the funds received could be used for one or more of three purposes: to supplement research on hush kits or re-engining programs to make B-727-200 and B-737-200 airplanes capable of meeting Stage 3 noise

standards; or to supplement the Airport Improvement Program to provide funds for soundproofing, land purchases, and other noise abatement practices; or to establish a fund to provide subsidized and guaranteed loans to prospective purchasers of Stage 3 aircraft.

Advantages

- Would allow continued use of noisier, but still serviceable, Stage 2 aircraft.
- Could provide revenues for noise abatement activities.
- Would provide flexibility to operators in deciding whether continued operation of Stage 2 aircraft or replacement with Stage 3 aircraft would be most efficient for their operations.

Disadvantages

- May not provide immediate relief to those adversely affected by aircraft noise.
- May present administrative difficulties depending upon plan adopted.
- The revenues derived from noise landing fees or surcharges might not be sufficient to make a significant contribution to noise research or airport noise abatement programs.
- Would require legislation if imposed at the Federal level.

Appendix I

LIST OF SPEAKERS

The following persons spoke at the public hearing on Aircraft Fleet Modernization, held December 10, 1985, at the Federal Aviation Administration in Washington, DC:

1.	Rep. Martin Sabo	Member of Congress
2.	Raymond G. Glumack	Minneapolis-St. Paul Metropolitan Airport
3.	Sen. Michael O. Freeman	Minnesota Legislature
4.	Wes Skogland	Minnesota Legislature
5.	Gov. Rudy Perpich	Minnesota
6.	Comm. Jan Del Calzo	Surrogate to Minneapolis Mayor
7.	Walter Rockenstein	Metropolitan Sound Abatement Council
8.	Mayor James Lindau	City of Bloomington, Minn.
9.	Mayor Bea Blomquist	City of Eagan, Minn.
10.	Susan McCloskey	Surrogate to Mayor of St. Paul
11.	Sandra Gardebring	Metropolitan Council
12.	Thomas A. Kalitowski	Minn. Polution Contol Agency
13.	Loren Simer	South Metro Airport Action Council
14.	Frederick W. Smith	Federal Express
15.	Leonard L. Griggs	St. Louis Airport Authority
16.	Bernard D. Hartman	St. Louis Airport Authority
17.	Kenneth B. Wallis	Noise Limited (A.A.T.I.)
18.	Donald A. MacDonald	McDonnell-Douglas Corporation
19.	Jeff Manley	TransAmerica Airlines
20.	Ald. Steve Cramer	City of Minneapolis
21.	Paul Bollinger	Amer. Assn. of Airport Executives
22.	John Cahill	Massachusetts Port Authority
23.	Morten S. Beyer	Avmark, Inc.
24.	Richard Deeds	Air Line Pilots Assn.
25.	Stanley Green	General Aviation Manufacturers Assn.
26.	Dorothy Poehlman	Citizens Against the Scatter Policy
27.	Oris W. Dunham Jr.	Los Angeles Dept. of Airports
28.	Edward O'Conner	Port of New York & New Jersey
29.	Gary Wright	Airport Operators Council, Inc.
30.	Richard Russell	Boeing Commercial Airplane Co.
31.	Thomas Greer	Burbank-Glendale-Pasadena Airport
32.	Paul Caplan	Norfolk International Airport
33.	Lori Palmer	City Council, Dallas, Texas
34.	Joseph Lewis	Hempstead, New York
35.	Stephen A. Alterman	Air Freight Association
36.	Herbert A. Rosenthal	Worldwide/Carefree Vacations
37.	John A. Hodges	McDermott, Will & Emery
38.	Joanne Young	Barrett Smith Shapiro Simon & Armstrong
39.	John Kopecky	Pratt & Whitney Aircraft Co.

LIST OF STATEMENTS

Written statements from the following persons were received by the FAA through January 31, 1986, in addition to statements submitted at the public hearing on Dec. 10, 1985.

1.	Michael A. Logrande	Town of Islip, New York
2.	Pat McDermott	City of Brighton, Colorado
3.	Hubert H. Humphrey III	Minnesota Attorney General
4.	Edward Hudson	European Civil Aviation Conference
5.	Wayne J. Yamasaki	State of Hawaii
6.	George F. Doughty	Denver/Stapleton International Airport
7.	J. Roger Fleming	Air Transport Association
8.	Raul F. Calvet Jr.	Lineas Aereas Paraguayas
9.	Robert E. Cohn	People Express Airlines
10.	John H. Hamilton	City of Richfield, Minnesota
11.	Darrell L. Weslander	Minneapolis-St. Paul Airport
12.	Sen. Dave Durenberger	Minnesota
13.	Arthur Lepore	City of Millbrae, California
14.	Herbert A. Rosenthal	DHL Airways, Inc.
15.	Martin J. Butler	Suburban O'Hare Commission
16.	Neilson A. Bertholf, Jr.	Phoenix Aviation Department
17.	E. L. Woulfe	City of Bloomington, Minnesota
18.	Phyllis B. Fordham	Arlington County, Virginia
19.	Les Totans	Reno/Cannon Airport Noise Council
20.	Clive L. DuVal	Virginians for Dulles
21.	Juan O'Callahan	Guinness Peat Aviation
22.	John R. Calhoun	City of Long Beach, California
23.	Rep. Thomas P. O'Neill, Jr.	Speaker of the House
24.	Rep. John J. Moakley	Member of Congress
25.	Rep. Edward J. Markey	Member of Congress
26.	Rep. Brian J. Donnelly	Member of Congress
27.	L.Kapor	General Electic Company
28.	Thomas N. Duffy	National Organization to Insure a Sound Environment
29.	Leroy Simpscn	Fokker Aircraft USA
30.	Joan M. Schuchman	Self
31.	George C. Bird	New York City, Community Board No. 11
32.	William E. Marek	Bensenville Envir. Prot. Coalition
33.	Fred B. Wood	Washington Airports Council
34.	Edward R. Beauvais	America West Airlines
35.	Dorothy L. Nieweg	Self
36.	Sen. Frank Padavan	New York State Legislature
37.	Gov. A. P Lutali	Territory of American Samoa
38.	Jack T. Knuepfer	DuPage County, Illinois
39.	Myra B. Herce	New York City, Community Board No. 7
40.	Sen. Paul Simon	Illinois
41.	Sen. Leonard P. Stavisky	New York State Senate
42.	Bill Cleator	Councilman, District 2, San Diego, Cal.

SPEAKERS SUPPORTING ALTERNATIVES

Alternatives	Speakers
Accelerated Depreciation:	Skoglund Kalitowski Griggs Hartman MacDonald Manley Caplan Young
Investment Tax Credits:	Glumack Skoglund Rockenstein Griggs Hartman MacDonald Wright (AOCI) Greer Caplan Young
Loan Guarantees:	Skoglund (from Aviat. Trust Fund) Caplan (from noise trust fund) Young
Stage 2 Non-Addition Rule:	Skoglund Griggs Greer
Stage 2 Operating Ban (Local):	Skoglund
Stage 2 Operating Ban (Fixed Date):	Glumack (1/1/95) Skoglund Kalitowski Smith (1/1/2000) Griggs Cramer Cahill O'Connor (1/1/95) Wright Lewis (1/1/95)
Stage 2 Operating Ban (Age):	Skoglund Griggs Hartman Greer Caplan

Federal Preemption:	Smith MacDonald Greer Alterman Rosenthal
Operational Flight Procedures:	Glumack (preference for Stage 3) Skoglund (" " ") Freeman Perpich Green
Operational Ground Procedures:	Skoglund (preference for Stage 3) Freeman
Noise Budgets:	Cramer Cahill (Massport rule)
Modify Current Noise Standards:	Glumack (More R&D) Skoglund Perpich Rockenstein Kalitowski Smith (Use Trust Fund for R&D) Griggs Hartman Wright Caplan Kopecky
Noise Fees:	Glumack (Tax on fuel) Del Calzo (Ticket tax) Rockenstein Kalitowski Manley (Compensate compliant carr. Cramer Caplan Lewis (Stage 4 R&D fr. noise fund)
Stage 2 Production Cut-off:	Glumack Skoglund Perpich Lindau Griggs (1/1/86) Hartman MacDonald Cramer Cahill O'Connor (1/1/87) Wright Greer Caplan (1/1/87) Lewis (1/1/87)

Strictly Enforce 1/1/88 Deadline:	Glumack Skoglund Rockenstein Lindau Wright
R&D for Stage 2 Retrofit/Reengine or Stage 4 Development:	Skoglund Griggs O'Connor (from Aviat. Trust Fund) Greer Rosenthal (paid fr. public funds)
Clarify FAA Policy on Local Options:	Skoglund Freeman
Limit G/A Operations:	Freeman
Expand Reliever Airports:	Freeman
Noise Sensitivity Training:	Freeman
Land Use (Zoning, insulation, etc.):	Perpich Smith (Trust Fund for Land Acq.
Immunity from Suit (Stage 3):	MacDonald Greer
Nighttime Ban on Stage 2:	Cahill
Federal Grants for Stage 3 Aircraft:	Beyer Greer (Noise fund for a/c purch.)
Anti-Trust Immunity:	Glumack

Appendix III

WRITTEN STATEMENTS SUPPORTING ALTERNATIVES

Alternatives	Statements
Accelerated Depreciation:	Fleming Calvet Cohn DuVal Calhoun Wood
Investment Tax Credits:	Fleming Calvet Cohn Hamilton Weslander Durenberger Rosenthal (DHL) DuVal Calhoun Kapor Wood Lutali Knuepfer
Loan Guarantees:	Marek
Stage 2 Non-Addition Rule:	Durenberger
Stage 2 Operating Ban (Local):	Knuepfer
Stage 2 Operating Ban (Fixed Date):	LoGrande McDermott Doughty (1/1/95) Hamilton (1/1/95) Durenberger Bertholf (1/1/95) Totaus Calhoun O'Neill Markey Moakley Donnelly Duffy (1/1/2000) Marek Cleator (1/1/2000)

Federal Preemption:	Cohn Rosenthal (DHL) Simpson
Operational Flight Procedures:	Fleming (exempt Stage 3 from rest.) Duffy
Noise Budgets:	LoGrande
Modify Current Noise Standards:	Durenberger Marek Knuepfer Duffy Cleator
Noise Fees:	DuVal (Landing fees) Calhoun (Landing fees or taxes) O'Neill (noise emission surcharge) Markey (" " ") Moakley (" " ") Donnelly (" " ") Lutali (Noise emissions tax) Knuepfer (Emissions tax & ldg. fee)
Stage 2 Production Cut-off:	McDermott Doughty Hamilton Durenberger Bertholf Totans Calhoun Duffy
Strictly Enforce 1/1/88 Deadline:	Hamilton Weslander Kapor Duffy
R&D for Stage 2 Retrofit/Reengine or Stage 4 Development:	Yamasaki Doughty Durenberger Lepore Rosenthal (DHL - subsidized R&D) Kapor Duffy Marek
Clarify FAA Policy on Local Options:	Cleator

Adopt National Fleet Mix Rule Required Phased-in of Stage 3:	**Doughty** **Weslander** **DuVal** **Duffy** **Wood** **Herce**
FAA Review of Proposed Airport Use Restrictions:	**Fleming**
Late Night Curfew for Stage 2:	**O'Neill** **Markey** **Moakley** **Donnelly** **Cleator**
Give Stage 3 Preference in FAA Rules:	**Duffy** **Cleator**

Appendix IV

METHODOLOGY FOR CALCULATING FLEET CONVERSION COSTS

The costs presented here address only the costs to the airline industry of premature retirement or, conversely, the discounted annual capital costs of purchase of new Stage 3 replacement aircraft. The economic measure of cost is not the gross purchase cost of a replacement aircraft in any particular year, but rather the reduction in service of the operators' current aircraft earlier than normal business decisions would dictate. Other costs such as training, tooling, equipment, etc., or cost-savings of Stage 3 aircraft operation, such as reduced fuel consumption, smaller crews, etc., are not considered in this analysis.

Costs as presented in Tables 4 and 5 were derived from the following calculation;

$$\text{Present Value cost}_{\text{year 1}} - \text{Present Value cost}_{\text{year 2}}$$

If we assume operator A is forced to ground an aircraft one year earlier than it would have absent a ban, the cost to this particular operator is the purchase cost in the year the regulation becomes effective (assume 1995 for this discussion), minus the present value of the aircraft purchase cost in the year of normal replacement (i.e., 1996). For example, assuming a purchase cost of $18 million and using constant dollars, the cost to this particular operator is $18 m - ($18 m * 1/1.06) = $1.02 m. This value represents the interest cost of a new purchase discounted by 6 percent to reflect the time value of money. Since no provision for inflation has been made, 6 percent will reflect the real cost of money over the analysis period.

To determine replacement costs for the whole fleet, the basic formula was simply expanded to include the total fleet attrition levels.

$$(P * \#\text{ of AC}) - (P * 1/1.06^{n} * \#\text{ of AC})$$

P = Price of Stage 3 replacement in year of proposed regulation;
# of AC = number of aircraft prematurely retired from forecast;
n = number of years of remaining useful life absent a ban; and
1/1.06 = 6 percent discount factor.

To determine the appropriate Stage 3 replacement aircraft, all Stage 2 aircraft were grouped in generic categories by range (Short Range-SR, Medium Range-MR, and Long Range-LR) and seat capacity (Table 4). Five categories were used, representing both current and future model types. Each Stage 2 aircraft was then replaced by a comparable Stage 3 version. Average selling prices were determined by tracking sales of these aircraft during 1985. All selling prices and subsequent costs are expressed in 1985 discounted dollars.

Analysis was performed for three possible implementation dates, 1995, 2000 and 2005. The numbers of Stage 2 aircraft in the fleet were determined from the FAA forecast in Table 1. To determine the costs associated with the premature end of the remaining useful life of an aircraft, it was necessary to assume yearly attrition rates from the official FAA forecast. To facilitate the analysis, several working assumptions were used. All purchases are assumed to be new aircraft, with purchases taking place at year end for discounting purposes.

Since the fleet forecast was presented in 5 year increments beyond 1995, normal yearly attrition rates were determined by taking the difference between those aircraft in service at the beginning of period 1 (1995) and period 2 (2000) and divided by 5, the number of years in the period. Table 4 presents the assumed rates. All Stage 2 models are assumed to reach their economic useful life by the year 2010, except for the LR-400 model for which the year 2015 was assumed. Once yearly attrition rates were determined the cost analysis was performed for each generic model type for the remaining assumed useful life.

Thus, as seen in Table 4 there are 682 Short Range, 110 seat model types forecast for the U.S. fleet in 1995, 385 in 2000, 233 in 2005 and by assumption, full attrition occurs by 2010. Thus, between periods 1 and 2, 298 aircraft would be retired irrespective of a regulation, with useful lives remaining of 1 year for 59 aircraft, 2 years for 59 aircraft, etc. Similar analysis was performed for each generic type for each 5 year baseline period.

Table 5 presents the total purchase cost in 1985 dollars for each period of analysis. The third column shows the normal investment flow based on the assumed attrition rates. This column was subtracted from the total purchase cost shown in the second column resulting in the total cost of an operating ban.

Since we assume all aircraft are retired at the end of their useful lives, the assumed residual values are zero. However, the purchase cost of new Stage 3 aircraft in any one period will, in reality, be somewhat less than those presented because some resale value will exist for most aircraft. This assumes, of course, that a market for good used aircraft will be available in countries which have not adopted an operating ban. Recent history indicates that the market value of used aircraft depends on a number of variables including: fuel prices, year of sale, availability of hush kits and future capital costs.

TABLE 4

NUMBER OF STAGE 2 AIRCRAFT BY YEAR OF RETIREMENT

CATEGORY	1985 Avg. Purchase Cost (millions)	1995	2000	2005	2010
SR 110	18.0	682	385	233	0
SR 160	25.0	591	381	141	0
MR 200	31.0	25	14	0	0
LR 270	39.0	82	66	33	0
LR 400	90.0	121	112	98	50
	Totals	1501	958	505	50
Total Replacement cost (In current year $$$)		$41,887	$29,486	$17,806	

ASSUMED YEARLY ATTRITION RATE

	1995-2000	2000-2005	2005-2010	2010-2015
SR 110	59.4	30.4	46.6	0
SR 160	42.0	48.0	28.2	0
MR 200	2.2	2.8	0	0
LR 270	3.2	6.6	6.6	0
LR 400	1.8	2.8	9.6	10.0

TABLE 5

TOTAL COST OF AN OPERATING BAN ON STAGE 2 AIRCRAFT
(1985 $$$)

YEAR	# of Stage 2 Aircraft	Total Purchase Cost	PV normal Investment Flow	Cost (85 $'s)
1995	1501	$23,405	$14,323	$ 9,082
2000	958	$12,304	$ 8,482	$ 3,822
2005	505	$ 5,553	$ 4,370	$ 1,183

Appendix V

METHODOLOGY FOR CALCULATION OF NOISE IMPACTS

Figure 3 displays the projected airport noise impacts, in terms of relative land areas within the Ldn 65 noise contours, for several forecast situations through the year 2005. These calculations were made in the following manner.

First, the numbers and types of aircraft in the U.S. fleet were forecast at 5-year intervals through the year 2005. These forecasts are displayed in Table 1 of the report.

Second, the average daily departures were determined from CAB/DOT historic utilization data for each type of aircraft in the fleet and were adjusted for future projections. For each type of aircraft, the number of aircraft was multiplied by the average daily departures to provide the total daily departures by that type of aircraft in the U.S. It was assumed that U.S. departures by foreign operators were balanced by departures by U.S. operators from foreign airports, as reflected in the average daily utilizations. Summing all of the daily departures for all aircraft types provided the calculated total departures at all U.S. airports for each future year.

Next, the total daily operations for each 5-year interval were adjusted to reflect the forecasts of total U.S. air carrier operations over this period of time (an average of 2.1 percent per year increase through the year 2005). These adjustments were then applied to the total daily departures for each type of aircraft at each future year.

Next, the adjusted total daily departures for each type of aircraft were divided by a constant factor (50) to represent the number of departures at an "average" U.S. major airport.

Finally, the areas of noise impacted land (areas within the Ldn 65 noise contours) were calculated using the Area Equivalent Method (see "Area Equivalent Method on LOTUS 1-2-3", FAA Report EE-84-12, July 1984). The calculated areas were lastly normalized to the base year 1985, for comparison.

For the years 1995, 2000, and 2005, the number of adjusted daily departures for all Stage 2 aircraft were assigned to correspondingly sized Stage 3 models, on an operation-for-operation basis. In these assignments, Stage 3 models with approximately the same number of seats were substituted for the Stage 2 models, but no attempt was made to match exactly the number of available seats. Calculations were repeated as before, using the Area Equivalent Method, to determine the projected impacts in each of the 3 future years for an all-Stage 3 fleet.